We claim:

1. A method for producing a genetically modified organism of the Blakeslea genus, which method comprises the following steps

   (i) transformation of at least one of the cells,

   (ii) optional homokaryotic conversion of the cells obtained in step (i) to produce cells in which one or more genetic characteristics of the nuclei are all modified in an identical manner and said genetic modification manifests itself in the cells, and

   (iii) selection and cultivation of the genetically modified cell or cells.

2. The method according to claim 1, **wherein** the cells are from fungi of the Blakeslea trispora species.

3. The method according to claim 1 or 2, **wherein** a vector or free nucleic acids are used in the transformation (i).

4. The method according to claim 3, **wherein** the vector employed in the transformation (i) is integrated into the genome of at least one of the cells.

5. The method according to claim 4, **wherein** the vector employed in the transformation (i) comprises a promoter and/or a terminator.

6. The method according to any of the preceding claims 3 to 5, **wherein** a vector comprising the gpd, pcarB, pcarRA and/or ptef1 promoter and/or the trpC terminator is employed in the transformation (i).

7. The method according to any of the preceding claims 3 to 6, **wherein** a vector comprising a resistance gene is employed in the transformation (i).

8. The method according to claim 7, **wherein** the vector employed in the transformation (i) comprises a hygromycin resistance gene (hph), in particular from E. coli.

9. The method according to any of the preceding claims 5 - 8, **wherein** the gpd promoter has the sequence SEQ ID NO: 1.

10. The method according to any of the preceding claims 5 - 8, **wherein** the trpC terminator has the sequence SEQ ID NO: 2.

11. The method according to any of the preceding claims 5 - 8, **wherein** the tef1 promoter has the sequence SEQ ID NO: 35.

12. The method according to any of claims 6 to 11, **wherein** the gpd promoter and the trpC terminator are derived from Aspergillus nidulans.

13. The method according to any of claims 3 to 12, **wherein** the vector comprises the SEQ ID NO: 3.

14. The method according to any of the preceding claims, **wherein** the transformation (i) is carried out using agrobacteria, conjugation, chemicals, electroporation, bombardment with DNA-loaded particles, protoplasts or microinjection.

15. The method according to any of the preceding claims, **wherein** a mutagenic agent is employed in the homokaryotic conversion (ii).

16. The method according to claim 15, **wherein** the mutagenic agent employed is N-methyl-N'-nitronitrosoguanidine (MNNG), UV radiation or X rays.

17. The method according to any of the preceding claims, **wherein** the selection is carried out by labeling and/or selecting the mononuclear cells.

18. The method according to any of the preceding claims 1 - 17, **wherein** 5-carbon-5-deazariboflavin (darf) and hygromycin (hyg) or 5-fluororotate (FOA) and uracil and hygromycin are employed in the selection.

19. The method according to any of claims 3 to 18, **wherein** the vector employed in the transformation (i) includes genetic information for producing carotenoids or their precursors.

20. The method according to any of claims 3 to 19, **wherein** the vector employed in the transformation (i) includes genetic information for producing carotenes or xanthophylls.

21. The method according to any of claims 3 to 20, **wherein** the vector employed in the transformation (i) includes genetic information for producing astaxanthin, zeaxanthin, echinenone, β-cryptoxanthin, andonixanthin, adonirubin, canthaxanthin, 3-hydroxyechinenone, 3'-hydroxyechinenone, lycopene, β-carotene, α-carotene, lutein, bixin, phytofluene or phytoene.

22. The method according to any of claims 3 to 21, **wherein** the vector employed in the transformation (i) is

30. The method according to any of claims 3 to 21, **wherein** the lycopene cyclase gene is switched off due to the transformation.

31. A genetically modified multinuclear cell of the fungi of the Blakeslea genus, in particular Blakeslea trispora, obtainable by any of the preceding claims.

32. The use of the cells according to claim 30 or of a mycelium formed therefrom for producing carotenoids or their precursors.

33. The use according to claim 30 or 31 for producing carotenes or xanthophylls.

34. The use according to any of claims 30 to 32 for producing astaxanthin, zeaxanthin, echinenone, β-cryptoxanthin, andonixanthin, adonirubin, canthaxanthin, 3-hydroxyechinenone, 3'-hydroxy-echinenone, lycopene, β-carotene, α-carotene, lutein, bixin, phytofluene or phytoene.

35. A promoter having the sequence SEQ ID NO: 1 or 35 for the use in the method according to any of claims 1 - 29.

36. A terminator having the sequence SEQ ID NO: 2 for the use in the method according to any of claims 1 - 29.

37. A vector comprising SEQ ID NO: 3 for the use in the method according to any of claims 1 - 29.

38. The vector according to claim 36 for the use in the method according to any of claims 1 - 29, comprising

SEQ ID NO: 69 and/or SEQ ID NO: 70 or 71 and/or 72 or 76.